



**WORLD
BROADBAND**
ASSOCIATION

Achieving Broadband Excellence:

2025 Best Practices Case Studies

www.WorldBroadbandAssociation.com

Foreword

In an era of rapid digital transformation, the broadband industry stands at the forefront of shaping inclusive, sustainable, and resilient societies. The World Broadband Association (WBBA) is proud to present the *Best Practices Case Studies Booklet*, a testament to the ingenuity, collaboration, and commitment of our global members.

This publication is more than a collection of success stories—it reflects the values that unite our community: innovation with purpose, excellence in execution, and a shared dedication to advancing broadband as a force for good. Through the *Broadband Excellence Advancing Community of Networks - BEACON “CONNECT”* Initiative, we have invited our members and Broadband Excellence Award 2025 finalists to contribute exemplary case studies that address real-world challenges with bold, scalable solutions.

I would like to extend special recognition to our WBBA General Manager, whose leadership and dedication were instrumental in driving this initiative forward—from concept to completion. We are also deeply grateful to our member representative and supporting analyst from Omdia, whose expert review and insights helped shape the selection and evaluation of these case studies. Their contributions added rigor and clarity, ensuring that each featured initiative meets the highest standards of relevance, innovation, and impact.

Most importantly, we thank the member organisations whose groundbreaking initiatives form the heart of this publication. Their willingness to share insights, data, and lessons learned has made this booklet a rich resource for the entire broadband ecosystem. Each case study reflects not only technical excellence but also a deep commitment to sustainability, customer-centricity, and industry progress.

To all contributors: thank you for your visionary work. May this booklet serve not only as a source of insight but also as a catalyst for continued excellence across our industry.

Together, we are building the networks excellence of tomorrow—connectivity that connect, uplift, and endure.

Martin Creaner

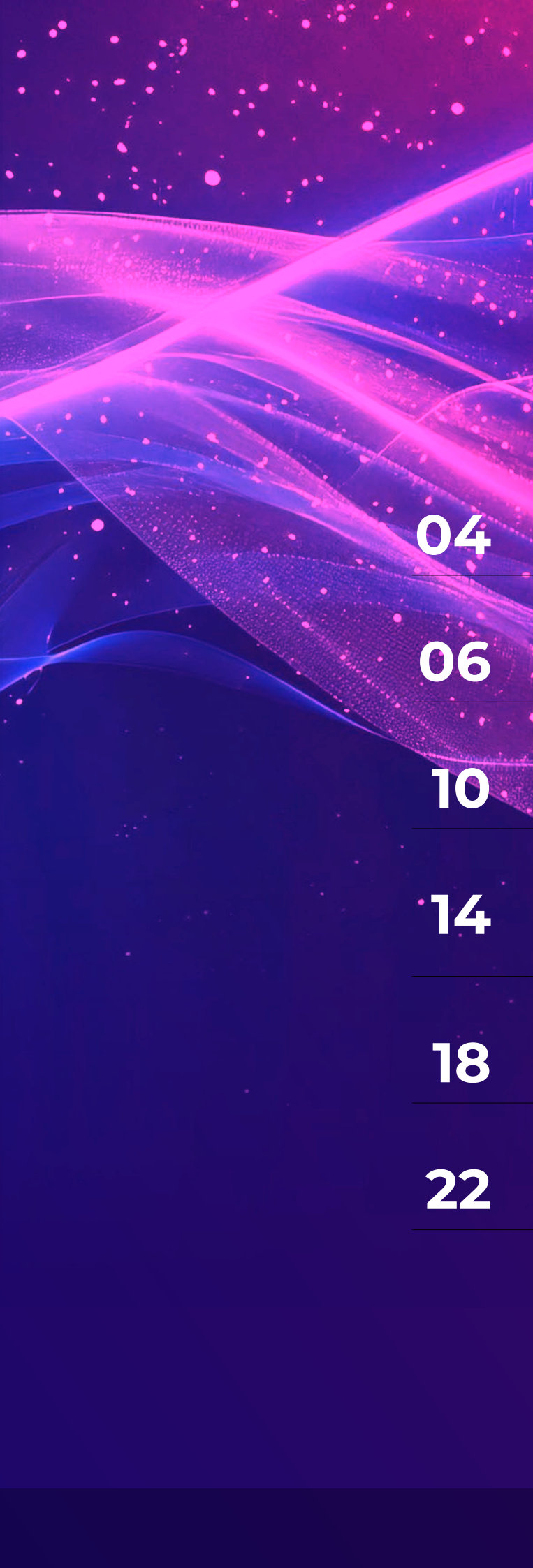
Director General
World Broadband Association (WBBA)

Acknowledgement

Nicole Cheah, General Manager of WBBA | Principal Consultant APAC, Intelligence & Advisory Omdia
Sonia Agnese, Senior Principal Analyst Latin America, Omdia

Member Organisations:





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Overview Summary

The World Broadband Association (WBBA) is proud to present the Best Practices Case Studies Booklet, a cornerstone of the Broadband Excellence Advancing Community of Networks (BEACON) – “CONNECT” Initiative.

This publication celebrates the outstanding achievements of WBBA members, and Broadband Excellence Award 2025 Finalists. It celebrates outstanding achievement and innovation across the global broadband ecosystem showcasing innovative solutions that address critical challenges in the broadband industry. By sharing these success stories, the WBBA aims to foster collaboration, inspire innovation, and contribute to the development of industry-wide best practices.

Each case study highlights creative approaches to problem-solving, tangible benefits to stakeholders, and practical applications for the broader broadband community. These initiatives not only demonstrate the transformative power of broadband technologies but also underscore the commitment of WBBA members to advancing sustainability, customer-centric solutions, and cutting-edge technologies.

Case Study Summaries



Fast Networks Malawi Connecting Classrooms, Empowering Communities

Fast Networks Malawi's initiative bridges the digital divide in rural Malawi by connecting 67 schools, deploying 20 community Wi-Fi hotspots, and establishing 4 network hubs. Through affordable voucher models and local capacity building, the project ensures sustainable, community-owned connectivity, empowering students, teachers, and local businesses.

Key Contributions:

- **Community Empowerment and ownership:** Enabled local entrepreneurs to generate income through network operations empowering education in a sustainable model.
- **Affordable Connectivity:** Introduced subsidized internet vouchers for schools and low-income households, implementing a technically flexible approach combining satellite, mesh, and cellular backhaul.
- **Sustainable Model:** Integrates school-focused connectivity with community-driven asset generation, fostering prosperity and ensuring long-term viability.



Raisecom Innovative Converged Optical Service Extend (OSE) Solution

Raisecom, in collaboration with China Unicom, introduced the world's first high-quality business leased-line solution using Optical Service Extend (OSE) and Optical Service Unit (OSU) technologies. This innovation significantly reduced costs by 80% compared to legacy systems and cut service time-to-market from weeks to hours. The solution ensures high-quality, low-latency connectivity for business clients, enabling efficient network migration and digital transformation.

Key Contributions:

- **Cost Efficiency:** Achieved 80% cost reduction compared to traditional methods, reducing the cost of single-user access by more than 50%.
- **Rapid Deployment:** Reduced service time-to-market from weeks to hours through automated provisioning.
- **Enhanced Service Quality:** Guaranteed SLA with low latency and jitter-free performance.

Achieving Broadband Excellence

Overview Summary



Tech Mahindra **Fast-Tracking Sustainable & Secure** **Broadband Network Connectivity** **& GTM: with an Integrated FTTx** **Services and Automation Framework**

Tech Mahindra's Integrated FTTx Services and Automation Framework accelerates next-generation broadband rollouts by addressing inefficiencies in fiber network deployment. By leveraging a unified platform and automation, the solution reduces design cycle times, optimizes resource utilization, and ensures seamless integration with existing systems. This approach has enabled faster, cost-effective, and scalable FTTx deployments, supporting CSPs in delivering future-proof connectivity.

Key Contributions:

- **Automation-Driven Efficiency:** Reduced design cycle time by up to 90%, enabling faster rollouts and ensuring up to 30% optimization in rollout costs.
- **Unified Platform:** Eliminated data silos and improved data integrity for consistent and accurate fiber network designs.
- **Scalable Deployment:** Built fiber designs for over 5 million homes, with 25,000+ nodes and audited on GIS & inventory platforms.



Turkcell & Huawei **FTTH Network Automation Project**

Turkcell partnered with Huawei to implement the FTTH Network Automation Project, integrating Huawei's SingleFAN Pro solution. This initiative optimized energy efficiency, reduced operational costs, and enhanced customer experience. Key innovations included AI-driven automation, zero-touch provisioning, and a five-level energy-saving system and OPEX reduction.

Key Contributions:

- **Energy Optimization:** Reduced power consumption by 1.88 GWh annually, saving \$300,000 in annual OPEX.
- **Operational Efficiency with AI-Driven Automation:** Achieved zero-touch ONT provisioning and streamlined "one-click" service activation, eliminating the need for on-site technician visits and significantly reducing operational costs. Additionally, enabled rapid fault resolution to enhance service reliability and scalability.
- **Sustainability Leadership:** Achieved 50% lower energy consumption than CoC v8 standards.



Trailblazer Broadband **Estes Park's Fiber-Enabled Smart** **Grid**

Town of Estes Park – Power & Communications (P&C) operates the municipal electric utility and Trailblazer Broadband, a town-owned FTTP network, developed Estes Park's Smart Mountain Community project that integrates municipal fiber, advanced metering, and grid-edge automation to enhance reliability, wildfire resilience, public-safety communications and critical-load protection. The initiative supports regional non-carbon transition roadmap while delivering community broadband and smart grid capabilities.

Key Contributions:

- **Reliable and Resilient Infrastructure:** Built a redundant fiber backbone supporting smart grid and broadband needs with a 49.3% take up rate and 100% municipality facilities on fiber.
- **Wildfire Mitigation:** Leveraged AMI (Advanced Metering Infrastructure) analytics for targeted maintenance and risk reduction.
- **Sustainability Goals:** Advanced in supporting the regional community's goal of achieving 100% non-carbon by 2030, with a roadmap that includes storage/DER orchestration (Distributed Energy Resources).



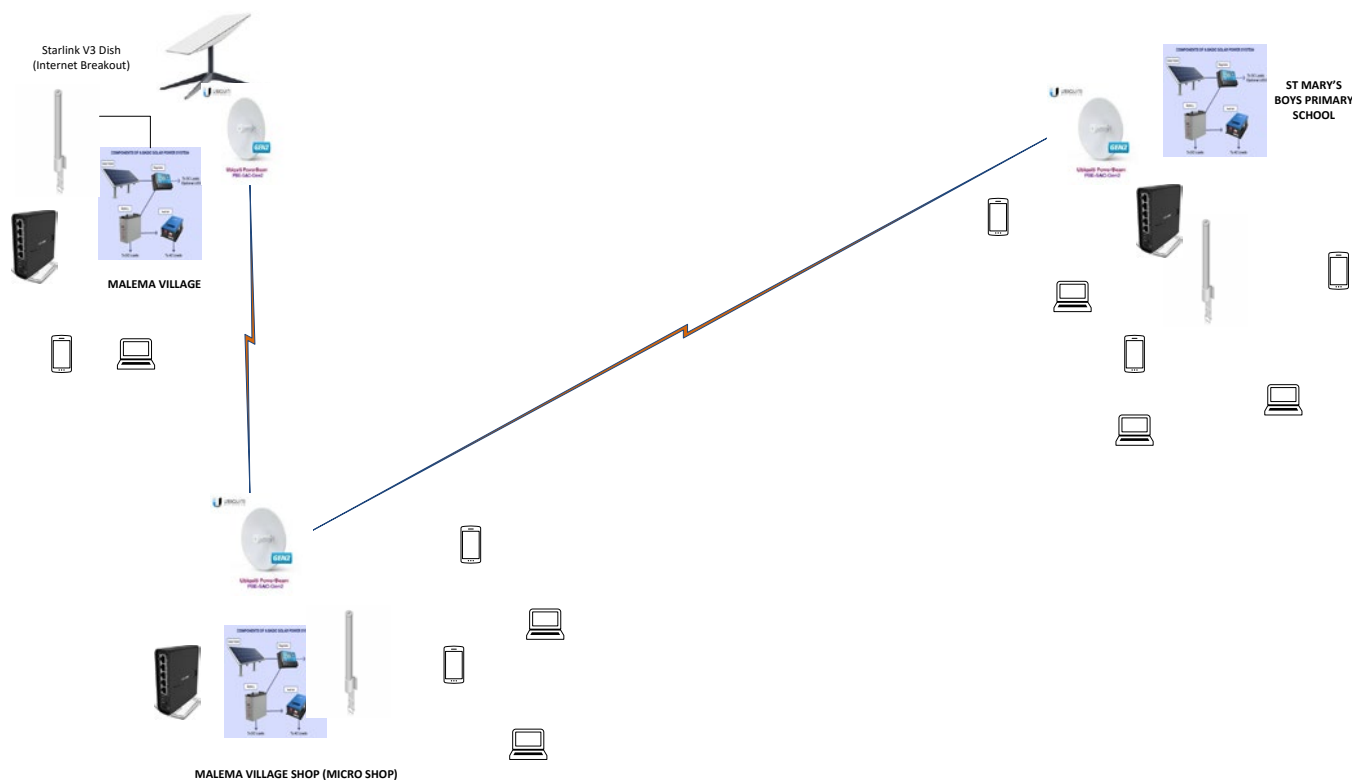
Connecting Classrooms, Empowering Communities

Overview

Company Overview: Fast Networks Malawi

Fast Networks Malawi is a digital inclusion pioneer dedicated to closing the connectivity gap in rural Malawi. We believe that internet access is not a privilege but a necessity for education, economic growth, and social empowerment. By designing sustainable, community-driven connectivity ecosystems, we are ensuring that schools, teachers, students, and local businesses have reliable and affordable access to the digital world.

MALEMA II VILLAGE SINGLE-HOMED NETWORK DRAWING



Project Executive Summary:

Our flagship initiative, **Connecting Classrooms, Empowering Communities**, tackles digital isolation in underserved regions. To date, we have connected 67 rural schools, deployed 20 community Wi-Fi hotspots, and established 4 community network hubs. Through affordable voucher models and local capacity building, Fast Networks ensures that connectivity is not just delivered but owned and sustained by communities themselves.



“Fast Networks ensures that connectivity is not just delivered but owned and sustained by communities themselves.”

Challenges Presented

Problem Statement:

Rural schools and communities in Malawi remain disconnected from the digital age, limiting access to education, training, and economic opportunities. Without reliable internet, learners cannot access online resources, teachers lack professional development platforms, and rural enterprises miss out on digital markets.

Specific Challenges:

- **High Internet Costs** – prohibitively expensive for rural schools and households.
- **Unreliable Power Supply** – frequent outages hinder network uptime.
- **Lack of Affordable Devices** – most learners and teachers cannot afford smartphones, laptops, or tablets.
- **Low Digital Literacy** – limited skills among students and educators restricts effective use of technology.
- **Proximity Yet Isolation** – many schools lie near trading centres but remain digitally excluded.

Constraints and Requirements

To succeed, solutions must be:

- **Affordable** – accessible to low-income households and schools.
- **Sustainable** – financially viable beyond donor support.
- **Scalable** – adaptable for remote villages and denser rural centres.
- **Community-Owned** – ensuring local entrepreneurs and households benefit directly.
- **Technically Flexible** – capable of combining satellite, mesh, and cellular backhaul depending on geography and cost.

Solution & Value

Solution Approach:

Fast Networks employs a four-pillar strategy:

1. **Targeted School Connectivity** – Prioritising rural schools with tailored broadband solutions.
2. **Community Anchor Networks** – Extending school networks into villages through hotspots and hubs.
3. **Affordable Voucher Models** – Subsidised internet vouchers generate income for local vendors while reducing costs for learners.
4. **Partnerships & Capacity Building** – Collaboration with education divisions, NGOs, and partners like the Turing Trust, World Mobile, unconnected.org, Inethi.org, Ubongo to address device shortages, provide content, and train technicians.

Impact, Innovation, and Value:

- **67 rural schools connected** to high-speed internet.
- **20 community Wi-Fi hotspots and 4 hubs** established, extending access beyond classrooms.
- **Affordable vouchers** empowering students and sustaining networks.
- **Local entrepreneurs** earning income from network operations.
- **Improved digital literacy** through device distribution and training initiatives.



Innovation & Sustainability:

Our blended operational model—school-focused connectivity paired with community-based voucher sales—creates a self-sustaining ecosystem. Technical flexibility (satellite, mesh, cellular backhaul) ensures adaptable, cost-effective deployments. This reduces donor dependency and makes connectivity a shared community asset.

Commercial Benefits

- Internet voucher sales generate revenue streams for both local entrepreneurs and Fast Networks.
- Schools gain cost-effective access to digital education resources, improving academic outcomes.
- Communities unlock economic opportunities in digital commerce, e-services, and communication.
- Sustainability ensures long-term value for partners, funders, and local stakeholders.

Key Learnings

- Connectivity must blend **educational and community value** to be sustainable.
- **Affordability and ownership** are critical drivers of adoption in rural communities.
- Technical **flexibility and local training** ensure resilience in challenging environments.
- Rural connectivity thrives when positioned not as a cost burden, but as a **community asset generating shared prosperity**.

“Without reliable internet, learners cannot access online resources, teachers lack professional development platforms, and rural enterprises miss out on digital markets.”

Innovative Converged Optical Service Extend (OSE) Solution

Overview

Company Overview: Raising Technology Co., Ltd. (China's leading telecommunication equipment manufacturer)

Raising is a world leading provider for optical networking equipment and comprehensive communication system solutions. Founded in 1999, it has been dedicated in research and development of communication technologies in the fields of all-optical networking, switching and routing, cloud-network convergence, edge computing and wireless networking, providing information-communication infrastructure as well as intelligent digital transformation solutions and services.

Headquartered in Beijing and listed on Shanghai Stock Exchange (SHA: 603803), Raising has been growing remarkably in last decade and serving partners and customers over 80 countries worldwide.

Consisted with more than three R&D centers and two manufacturing facilities in China, Raising is capable of harnessing local talents and supply chain resource to design, develop and provide best-in-class cost-efficient products. Through well-established local representative offices and branch companies spread in every continent, Raising has always been dedicated to providing tailored Packet Transport, Optical Transport, Broadband Access, Industrial and IoT Networking solutions to its service provider and vertical industry customers locally.

Project Executive Summary:

Jointly invented and developed by Raisecom and China Unicom Beijing Branch, the world's first high-quality business leased-line was introduced to service based on converged Optical Service Extend (OSE) and Optical Service Unit (OSU) technologies.

Based on its IP+Optical converged technology, Raisecom has designed the unique OSE+OSU leased-line solution, which significantly improves the cost-efficiency by 80% comparing to legacy ways and reduces service time-to-market from weeks to hours. It's highly convinced that the new high-quality business leased-line will facilitate efficiently CSP network migration and digital transformation, while keeping their most revenue-generating products unaffected.

The OSE solution combines optimized light splitting, fixed bandwidth allocation and OSU/ODUk convergence to provision end-to-end services automatically and guarantee SLA by unified controller and NMS platform.

Challenges Presented

Problem Statement:

Along with legacy SDH being phased out due to low fiber utilization, long time-to-market, and complicated operation, latency-sensitive business clients lack of competent and cost-efficient hard-pipe based leased-line solution when CSP moves to all IP over DWDM/OTN.

Specific Challenges:

- An efficient point-to-multipoint solution is needed to replace the traditional SDH point-to-point mode and increase the coverage of the access layer.
- A fine granularity container is needed to carry services and ensure services quality.
- Must come with an end-to-end provisioning and management.

Constraints and Requirements:

- Develop a comprehensive solution to apply the access layer point-to-point solution to dedicated line services, replacing traditional point-to-point access methods and reducing deployment costs.
- Apply fine-granularity containers to replace traditional VC containers and efficiently integrate into OTN networks.
- Complete the mapping, aggregation, and scheduling of fine-granularity services, and perform end-to-end management

Figure 1: Raisecom OSE Solution Topology

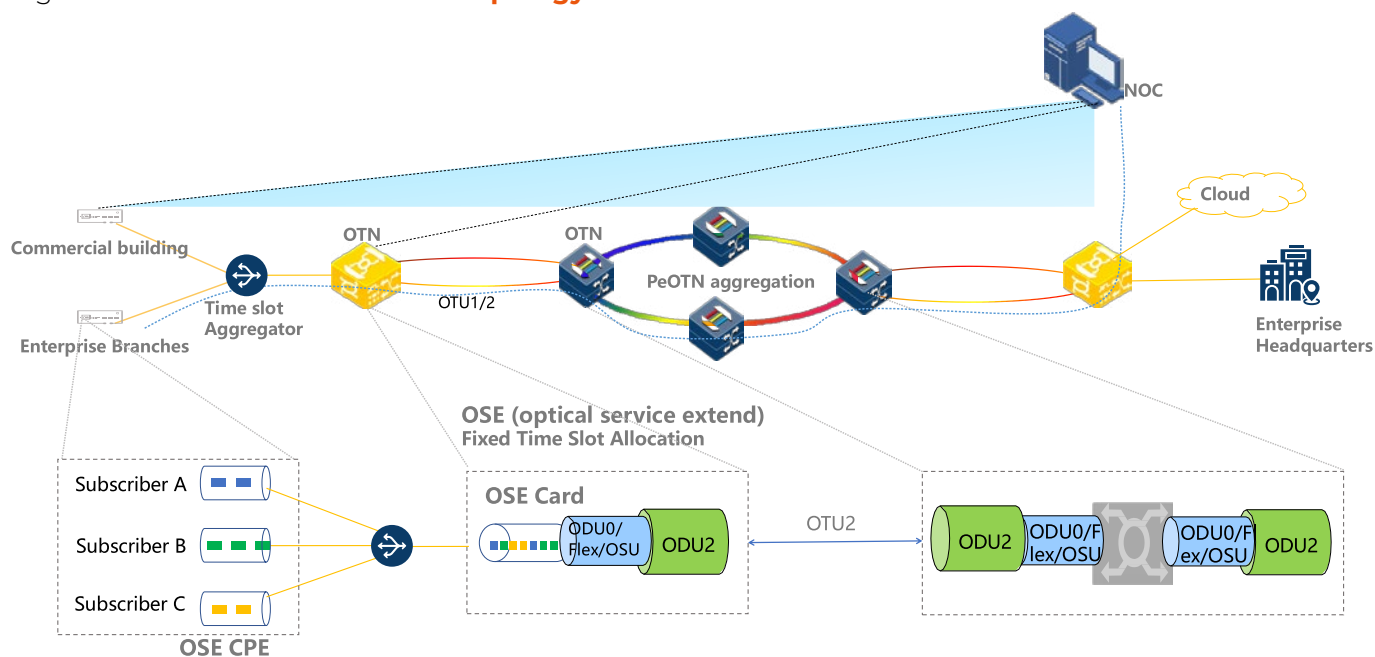
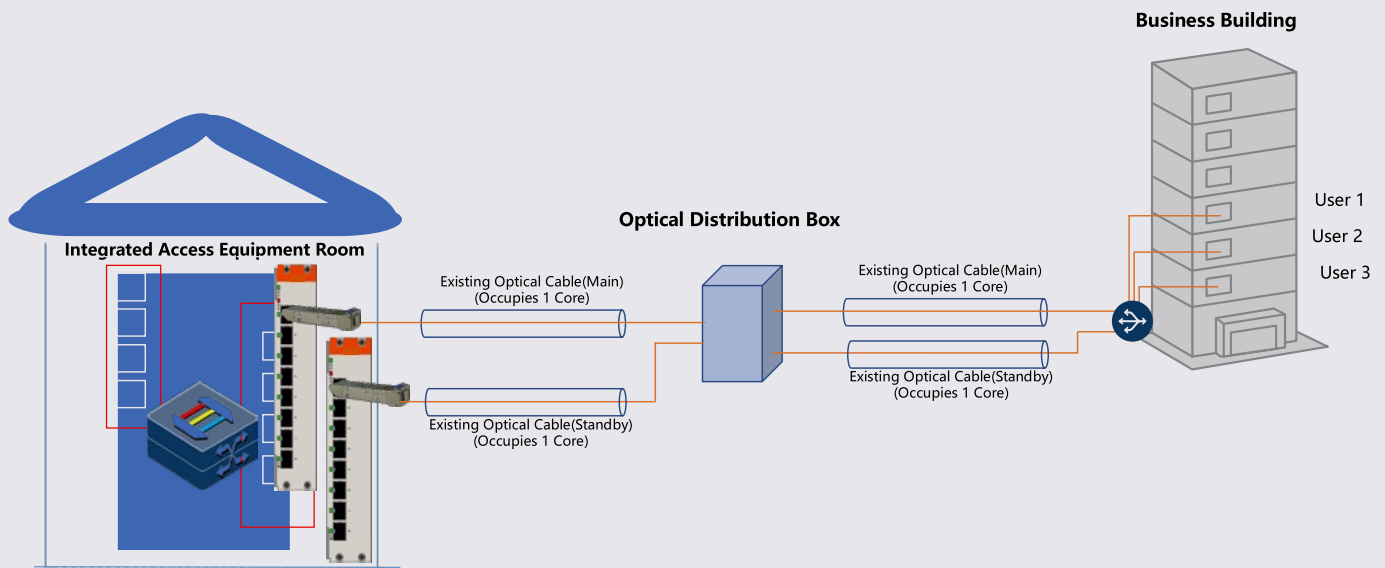


Figure 2: Innovative structure of Leased-line service network with OSE



Solution & Value

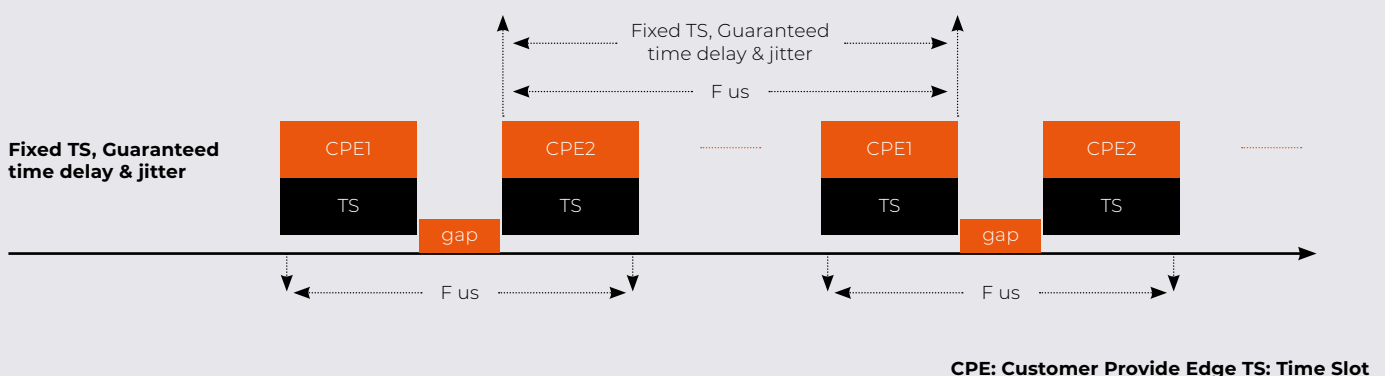
Solution Approach:

- Optical splitters are deployed in optical distribution boxes close to customer end, separating residential from business services. In PON massive deployment context, the OSE technology requires little investment on POP site but enables CSP to deliver high-quality business leased lines instantly, which contributes the significant part of CSP revenue profit.
- Fixed bandwidth allocation (FBA) technology is different from DBA of PON. It pre-allocates a fixed

number and timing slot resources to each CPE, and eliminates the process of negotiating and reduces data transmission delays. At the same time, the jitter introduced by DBA is also eliminated.

Fixed bandwidth allocation (FBA) technology is introduced to reduce the end-to-end transmission delay and eliminate jitter. Comparing with DBA in PON, each business CPE is ensured with exclusive fixed bandwidth, predetermined service priority, and guaranteed highest-level information security because of not mixing services from different tenants. A flexible range of 2M to 100G service definition is provided for CSP to customize their own business products.

Figure 3: Innovative structure on CPE site



Intelligent Operation & OAM:

With intelligent NMS & controllers in multi-domain, OSE technology implements service automatic provisioning, end-to-end low latency guarantee and jitter elimination, as well as traffic diagnosis and instant failure restoration.

Impact, Innovation, and Value:

- **Solution Impact:** In collaboration with China Unicom Beijing Branch, Raisecom has deployed its iTN8600 with OSE in early 2025, kicking-off the world's first cloud-connected OTN business leased-line network in Beijing Economic Development Zone. This breakthrough marks a new stage of service versatility in optical transport network and provides a powerful engine for communication network modernization and operation digitalization.
- **Technology Innovation:** Based on converged Optical Service Extend (OSE) and Optical Service Unit (OSU) technologies, a new solution has been developed to simplify the network architecture.
- **Value:** The new technology improves services

deployment efficiency, significantly reduces capital and operational expenditure, and enhances network coverage.

Commercial Benefits:

The OSE infrastructure supports community leased-line service development in a significant economic way. Below diagram shows a rough calculation: the OSE technology provides greatly optimized CapEx and reduced OpEx helping operators significantly increase revenue profit.

Key Learnings:

- Technological innovation has greatly improved network efficiency and brought massive business opportunities.
- Silent existing resources are revitalized: the deployed PON network resources can be utilized in the new applications.
- High-quality business Leased-Line is endowed with more reliable quality assurance and intelligent management methods.

Figure 4: **Intelligent Operation**

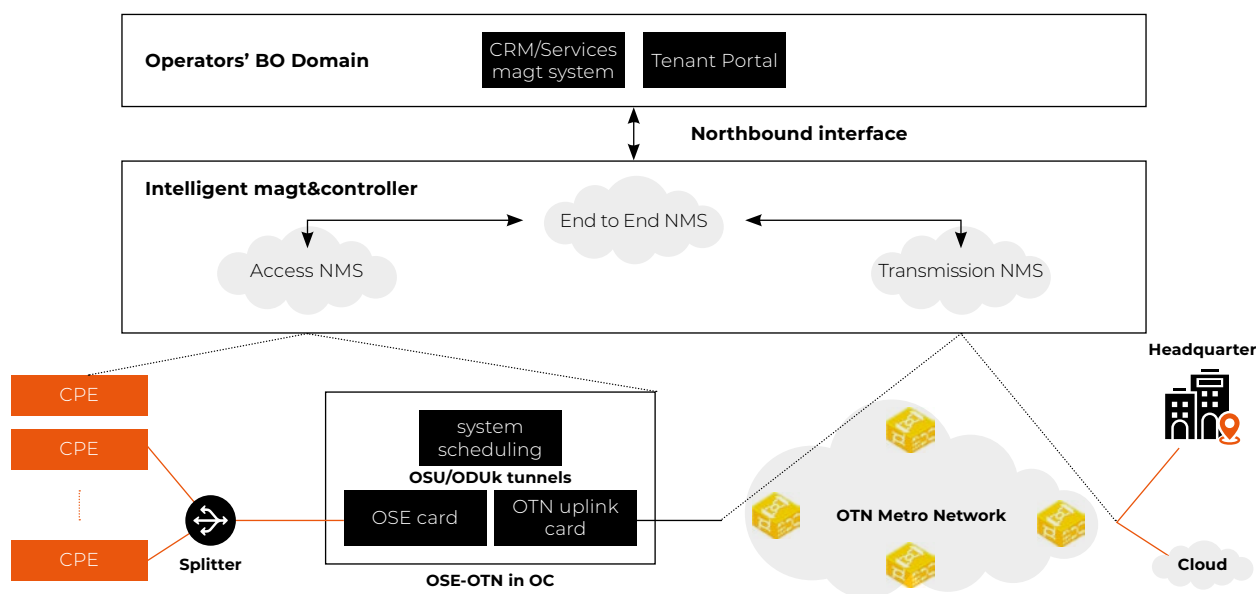


Figure 5: **Commercial Benefits**

Scenarios	Access Way	Central Room (CNY/line)	Terminal (CNY/line)	Cables of Access Segment (CNY/line)	TCO (CNY/line)	
GE port access with fiber	GE port access exclusive with fiber directly	800¥	1400¥	6600¥	8800¥	Reduce the cost of single-user access by more than 50%
	GE port access sharing with OSE	100¥	1600¥	2400¥	4100¥	

Fast-Tracking Sustainable & Secure Broadband Network Connectivity & GTM: with an Integrated FTTx Services and Automation Framework

Overview

Company Overview: Tech Mahindra

Tech Mahindra offers technology consulting and digital solutions to global enterprises across industries, enabling transformative scale at unparalleled speed. With 148,000+ professionals across 90+ countries helping 1100+ clients, Tech Mahindra provides a full spectrum of services including consulting, information technology, enterprise applications, business process services, engineering services, network services, customer experience & design, AI & analytics, and cloud & infrastructure services. It has 30+ years of expertise in the communications domain, and end-to-end telecom lifecycle management capabilities, which make it a trusted partner to broadband providers, empowering them to build and scale next-generation networks across Fiber, Cable, FWA, and Satellite.

Achieving Broadband Excellence

Fast-Tracking Sustainable & Secure Broadband Network Connectivity & GTM with an Integrated FTTx Services and Automation Framework

TECH
mahindra

Project Executive Summary:

Amidst rising demand for applications and technologies that require reliable, low-latency, and secure connectivity, broadband has emerged as a foundational enabler of digital transformation across industries (retail and wholesale) by supporting the exponential growth of data and the need for seamless connectivity.

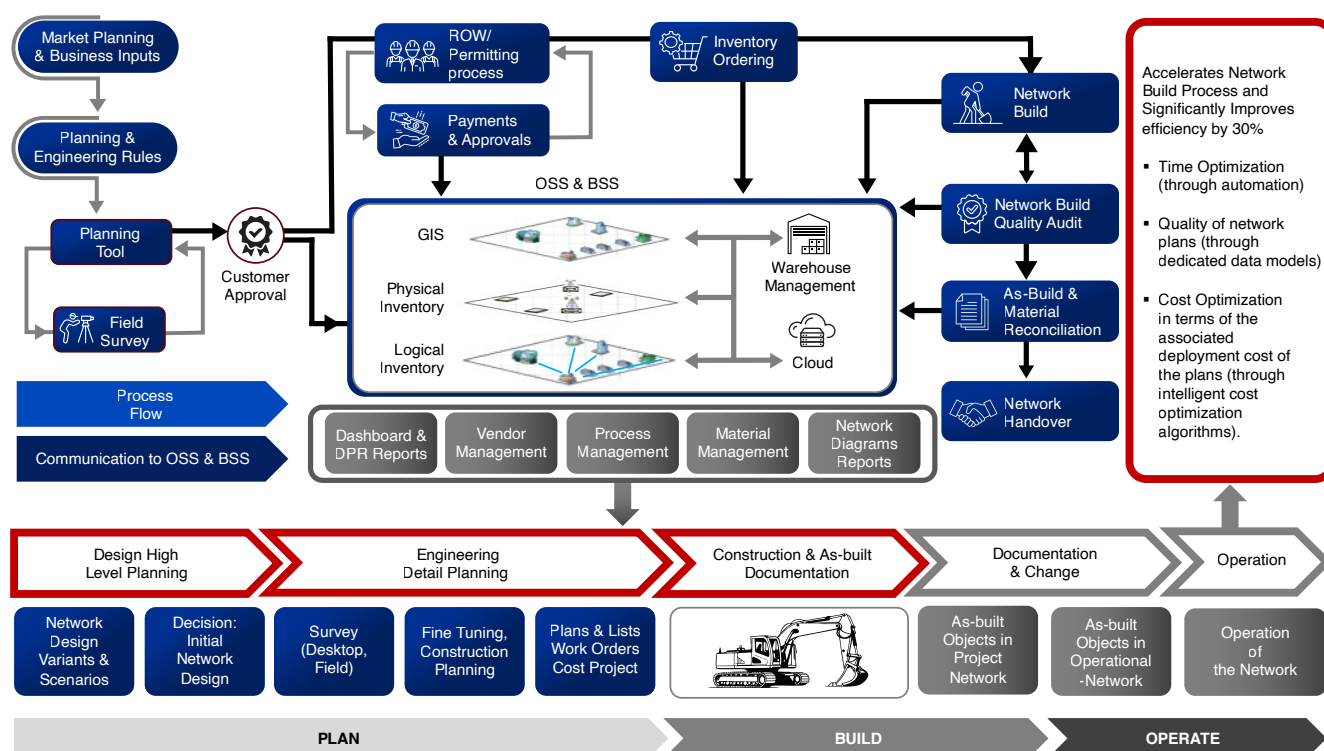
As broadband providers build and scale next-generation access networks across Fiber, Cable, Fixed Wireless Access, and Satellite, one key solution facilitating the transition from legacy copper-based networks to high-capacity fiber infrastructure is Fiber to the X (FTTx). This shift not only enhances fixed access networks but also strengthens advanced wireless networks through improved backhaul capacity- delivering ultra-high-speed, low-latency connectivity.

Tech Mahindra's innovative approach to broadband infrastructure is encapsulated in its Integrated Services & Automation Suite, designed to fast-track next-generation FTTx rollouts while optimizing total cost of ownership (TCO). As illustrated in Figure 1, the suite offers a unified platform that integrates seamlessly with existing telco systems, enabling data correlation and resolving issues related to data inconsistency and integrity.

With end-to-end capabilities, the solution empowers Communication Service Providers (CSPs) to deliver future-proof connectivity across both fixed and wireless networks through services spanning:

- 1. Network Consulting, Planning, Design, Engineering & Cost Analysis**
- 2. Network Rollout**
- 3. Network Management**

Figure 1: **Integrated Services & Automation Suite**



Achieving Broadband Excellence

Fast-Tracking Sustainable & Secure Broadband Network Connectivity & GTM with an Integrated FTTx Services and Automation Framework

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Challenges Being Addressed:

CSPs, especially the ones operating in the broadband domain face mounting pressure from mobile and Wi-Fi competitors, compounded by the convergence of fixed, mobile, data, and cable networks. The deployment of FTTx networks is hindered by fragmented systems, manual design processes, and inconsistent data across platforms. These inefficiencies result in prolonged rollout cycles, inaccurate designs, and underutilization of costly fiber assets. The absence of a unified planning and inventory system further exacerbates operational complexity and delays.

In order to devise a cost-effective way of FTTx network deployment, the role of an experienced design, build, operate & maintain partner is crucial.

Solution & Value

Solution Approach:

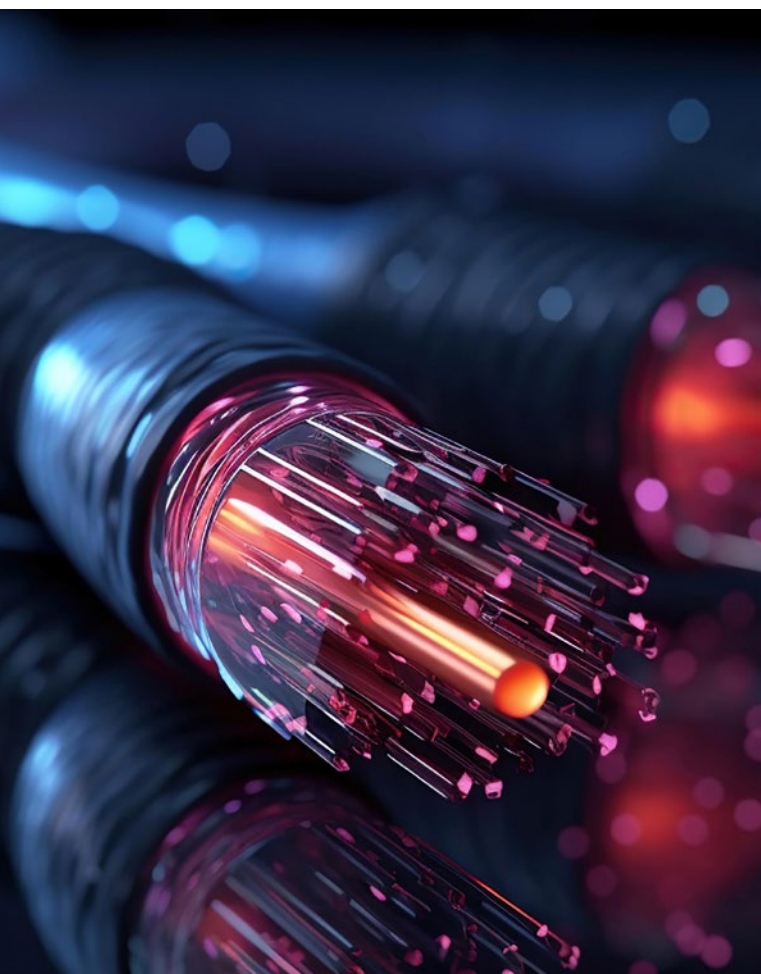
Tech Mahindra's end-to-end FTTx service suite addresses these challenges through a strategic blend of consulting, planning, engineering, rollout, and network management. The solution is underpinned by an automation wrapper that enhances rollout speed, quality, and cost efficiency.

Key highlights of the solution include:

- **Unified Platform:** A single source of truth for fiber inventory, integrating with CSPs' existing systems to ensure data correlation and integrity.
- **Automated Design & Pathfinding:** Intelligent algorithms enable auto-design and route optimization, drastically reducing manual effort and cycle time.
- **Strategic Planning Frameworks:** High-level and detailed network planning processes convert strategic decisions into actionable build plans, ensuring regulatory compliance and construction readiness.
- **Technology Upgrades:** Support for XGS-PON migration and DCOSIS expansion balances CAPEX and OPEX while driving revenue growth.
- **Collaborative Engineering:** Joint planning with CSP teams ensures optimal network function placement and connectivity decisions.

This operational model not only consolidates fiber planning and design practices but also introduces scalable automation to streamline deployment and maintenance. Here are some key milestones of this solution:

1. **Plan:**
 - a. **Site Planning:** Fiber network roadmap created from "as-is" to "to-be", while proposing target areas for future upgrades
 - b. **Feasibility:** High-level business inputs, desktop feasibility and budgetary costing
2. **Design:**
 - a. **High-level design:** consisting of survey pack and fiber reservation
 - b. **Cost [BoQ-BoM] Approval:** allocation, validation and approval of costs
 - c. **Site Survey (Design Support):** approval of survey pack and review of fiber allocation
 - d. **Low-Level Design:** Detailed design created with BoQ-BoM approval



Achieving Broadband Excellence

Fast-Tracking Sustainable & Secure Broadband Network Connectivity & GTM with an Integrated FTTx Services and Automation Framework

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3. Build:

- a. **Build (Support):** Cost variation and design approvals
- b. **As-Built Inventory Update:** Status check of as-built and inventory clean-up
- c. **Invoicing/ Documentation:** Approval of invoices, technical documents etc.

4. Operate & Maintain:

Fault analysis, network outage planning and support, and network re-routing

Impact, Innovation, and Value:

Our solution transforms CSPs’ broadband rollout capabilities by providing a unified platform that eliminates data silos and ensures accurate, consistent fiber network designs.

- With **1200+ fiber specialists**, the solution has helped improve network planning and process design quick turnarounds as well as service qualification for better address management.
- It has built fiber designs for **over 5 million homes** with **25,000+ nodes planned and audited on GIS & inventory platforms**.
- Moreover, the on time delivery of planning assignments has helped **improve cycle time by up to 90%+ (14 weeks to less than 1 week)**.

Commercial Benefits:

- The solution uses automation to reduce design cycle time, **having automated fiber design for last mile by 65%**. This also helps enhance resource reuse, leading to **up to 30% savings due to cost and effort reduction**.
- Strategic planning ensures infrastructure decisions are aligned with local conditions and business goals, **ensuring up to 30% optimization in rollout costs**.



As a result, CSPs can accelerate triple and quadruple-play service rollouts, improve customer experience through reliable high-speed access, and achieve sustainable growth with optimized investments. By future-proofing FTTx deployments, Tech Mahindra positions its partners at the forefront of digital connectivity innovation.

Key Learnings:

1. Importance of unified platforms:

- A centralized system for fiber inventory and planning eliminates data silos, improves data integrity, and accelerates network rollout.
- Integration with existing CSP systems ensures seamless operations and better decision-making.

2. Automation as a catalyst for efficiency and cost reduction:

- Automated design and route optimization reduces manual effort, design cycle time and leads to better utilisation of resources.

Estes Park's Fiber-Enabled Smart Grid

Overview

Town of Estes Park – Power & Communications (P&C) operates the municipal electric utility and **Trailblazer Broadband** (FTTP). Trailblazer is the digital backbone for smart-grid telemetry (AMI/SCADA) and municipal/public-safety communications—engineered for **ultra-reliable, low-latency** connectivity that enables **next-generation digital experiences**. (11,250 electric customers; 350 sq mi service area; **82% premises passed; 49.3% take-rate; 100% municipal/critical facilities on fiber.**)

Project Executive Summary

- **Platform:** A redundant municipal fiber fabric (four-node core, diverse middle-mile) engineered for deterministic reliability and low latency across utility ops and community broadband.
- **Future-apps ready:** Symmetric, low-latency fiber with intelligent paths for AI-assisted operations, XR/3D learning, telehealth, and cloud/edge workloads.
- **Resilience:** Triple-path connectivity, including an Adams Tunnel emergency route; LETA 911 interoperability enhancements underway.
- **Grid modernization:** AMI analytics, dashboards, and risk-aware operations (Red Flag posture, non-reclose controls) shorten restoration time and lower ignition risk.
- **Coverage & adoption:** 82% of customers serviceable within ~11% of land area; 49.3% take-rate.
- **Buildout & plant:** 361 linear fiber miles in service (58% aerial / 42% UG); ~83.2 miles remaining.
- **Reliability recognition:** APPA Certificate of Excellence in Reliability — 2023 (certificate on file) and 2024 (APPA list).
- **Outcomes:** SAIDI trend (minutes): '22: 51.11; '23: 72.24; '24: 42.47.

Challenges Presented

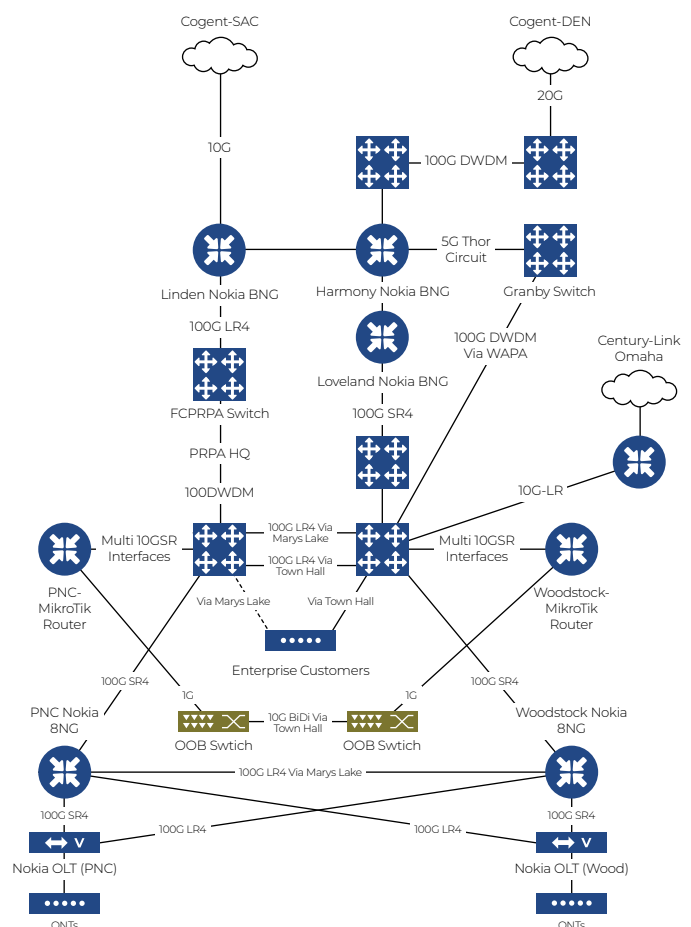
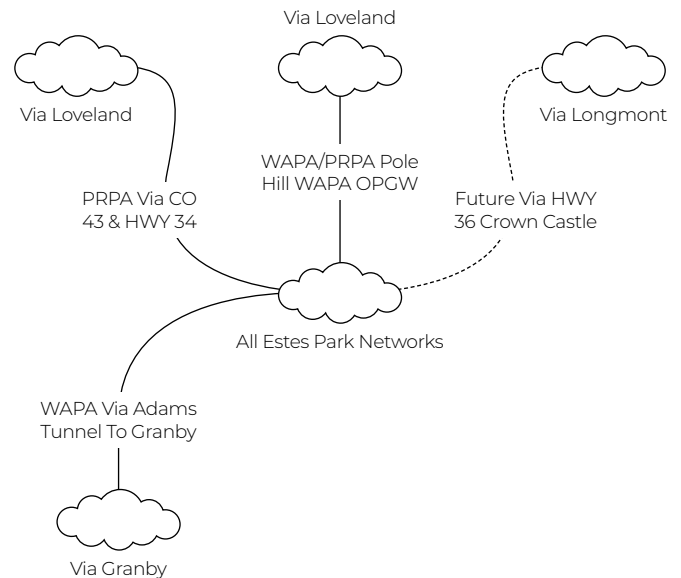
Problem Statement

A rural mountain topology with long radial corridors, severe weather, and wildfire risk increases fault exposure and access times. Legacy communications constrained **telemetry, protection, and restoration**, while community needs demanded **ultra-low-latency**, resilient broadband for AI/immersive, telehealth, and public-safety use.

Specific Challenges

- **Single-contingency exposure** on mountain feeders; limited telemetry delays fault location
- **Wildfire ignition risk** without data-driven inspections/vegetation targeting
- **Critical-load continuity** (hospital/EOC/fire) needs low-latency comms and sectionalizing/islanding readiness
- **Affordability & equity:** advancing modernization while protecting customer outcomes

Figure 1: **Redundant municipal fiber platform** (four-node core, diverse paths, Adams Tunnel emergency route)



Achieving Broadband Excellence Estes Park's Fiber-Enabled Smart Grid



Constraints & Requirements

- **Always-on, geo-diverse communications** for AMI/ SCADA/protection and public safety
- **Deterministic low latency** for future apps (XR, cloud gaming, AI inference at edge)
- **Security segmentation** between utility telemetry and public broadband
- **Scalability** to extend from high-density pockets into low-density terrain efficiently

“Trailblazer shows how a small mountain community can future-proof broadband for the next wave of applications.”

Solution & Value

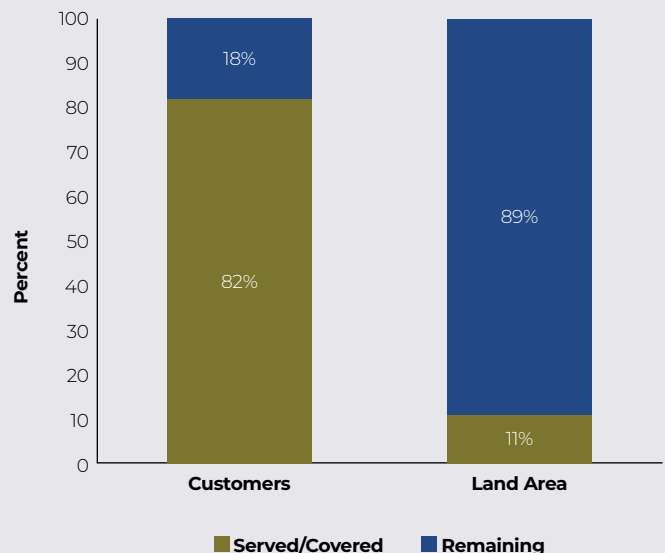
Impact, Innovation & Value

- **Future-apps platform:** Symmetric, low-latency fiber enables AI-enabled services, XR/3D learning, telehealth, and cloud/edge workloads for residents and businesses
- **Critical comms:** 100% of municipal and critical facilities on fiber (hospital, EOC, fire, police, water, public works, schools, YMCA)
- **Reliability:** SAIDI (min) '22 51.11 | '23 72.24 | '24 42.47; faster fault location and sectionalizing.
- **Adoption & reach:** 82% premises passed, 49.3% take-rate,
- **Resilience:** Triple-path design and emergency east-west route sustain operations through wildfire/ weather events
- **Recognition:** APPA Certificate of Excellence in Reliability — 2023 (on file) & 2024 (APPA list)

Solution Approach

- **Segmented municipal fiber** as a shared control/backhaul plane for **AMI, SCADA, protection, and community broadband**, with hardened nodes and backup power
- **Diverse routes** (incl. **Adams Tunnel** emergency path) sustain **911** and grid operations in crises; **LETA 911** integration strengthens interoperability
- **AMI analytics & dashboards** surface incipient issues (voltage anomalies, momentaries), target patrols/repairs, and accelerate restorations
- **Risk-aware operations:** Red Flag posture, **non-reclose/one-shot** by feeder, and authority to **de-energize targeted spans** when thresholds are exceeded
- **DER-aligned roadmap** with PRPA enables **AI-assisted optimization** of loads, storage, and demand response as participation scales

Figure 2: **Coverage reality**
~82% of customers within ~11% land



- **Buildout strategy:** complete **~83.2 mi** to reach the final **18%** of customers across **~89%** of land—prioritizing reliability first, then density-aware expansions

Commercial Benefits

- **OPEX reduction** (remote reads/analytics, targeted truck rolls)
- **Continuity of operations** for public safety, healthcare, and local businesses
- **Scalable pattern** for rural mountain communities: **municipal fiber + utility analytics + safety & resilience**

Achieving Broadband Excellence

Estes Park's Fiber-Enabled Smart Grid



Partnership Model & Replicability

- **Public-public:** Town P&C + PRPA alignment (resource diversification, grid data) with municipal control of fiber
- **Regional safety:** LETA 911 and regional carrier partners; proven emergency routing across the Adams Tunnel

Key Learnings

- **Build fiber first;** segmentation & redundancy enable secure, low-latency automation at scale
- **Tie data to action;** analytics must drive playbooks (vegetation, FLISR/sectionalizing) to move KPIs
- **Design for islanding/ride-through early;** avoid bolt-on retrofits as DER/EV load grows

KPIs & Validation

- **Premises passed: 82%** (electric customers who can order)
- **Broadband footprint: ~38 / 350 sq mi** (~ 11% land area); remaining **18%** of across **~89%** land
- **Take-rate: 49.3%** (residential + commercial)
- **Critical facilities on fiber: 100%**
- **Fiber installed and in service: 361 mi; ~83.2 mi** remaining.
- **Reliability (SAIDI, min; IEEE 1366): '22 51.11 | '23 72.24 | '24 42.47**
- **Recognition: APPA Certificate of Excellence in Reliability—2023** (certificate on file) & **2024** (APPA recipients list)

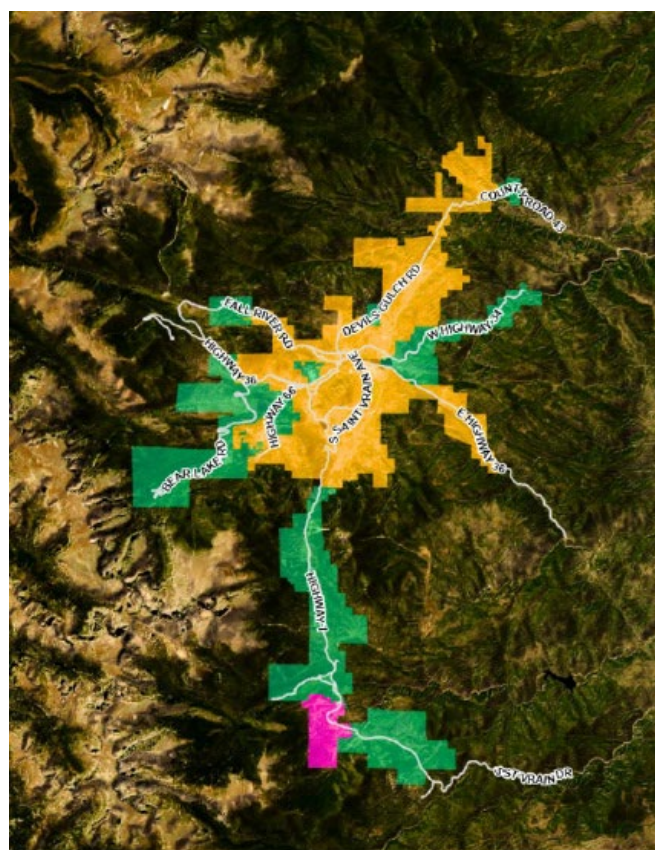
Future Applications Spotlight

- **AI-assisted operations.** Low-latency fiber + AMI analytics enable faster fault-location, sectionalizing, and data-driven maintenance—foundations for ADMS/DERMS and edge inference at scale.
- **XR/3D learning & cloud workloads.** Symmetric throughput and predictable latency support real-time collaboration, rendering, and immersive curricula—ready for classrooms, labs, and workforce training.
- **Telehealth & safety.** Deterministic connectivity for high-quality video, remote diagnostics, and public-safety coordination across hospital, EOC, police, fire, and municipal sites.

Why This Wins

Trailblazer shows how a small mountain community can **future-proof broadband** for the next wave of applications: a **single, resilient municipal fiber fabric** segmented for utility and community use; **ultra-low latency** for AI/XR/cloud; and **operational intelligence** that cuts restoration time and mitigates wildfire risk. With **82% of customers serviceable within ~11% of land**, and a **reliability program recognized by APPA**, the platform is built to scale—turning hard geography into an innovation advantage.

Figure 3: **Available & future broadband service areas**



Trailblazer Broadband – Smart Gigacity – Exhibit B2 – Coverage & Take-Rate

- Service Available Area - 49.3% Take Rate
- Opening Soon
- Phase 4 Construction



Turkcell & Huawei FTTH Network Automation Project

Overview

Company Overview: Turkcell (Turkcell İletişim Hizmetleri)

Founded in 1994 as Türkiye's first GSM operator, Turkcell has rapidly evolved into the country's leading telecommunications brand. Building on its leadership in mobile communications, Turkcell has expanded into fixed broadband and fiber solutions, reinforcing its position as a key driver of Türkiye's digital transformation. With more than 67,000 km of backbone fiber, fiber access available to 6.3 million households, and over 2.5 million subscribers, Turkcell provides reliable, high-speed connectivity solutions that serve both individuals and businesses across the country.

Beyond its role as a telecom operator, Turkcell has transformed into an integrated technology company offering a diverse portfolio of digital services, cloud solutions, AI-powered applications, and network management systems designed with energy efficiency at the core. By developing proprietary applications, smart Wi-Fi solutions, and next-generation fiber networks capable of delivering up to 10 Gbps, Turkcell addresses the evolving needs of both consumer and enterprise customers. At the same time, its continued fiber expansion strengthens the foundation for 5G deployment and supports the future development of smart cities across Türkiye.

Turkcell's sustainability vision is defined not only by technological innovation but also by its environmental and social contributions. Through smart energy-saving initiatives, the company aims to reduce network energy consumption by up to 38%, lowering its carbon footprint and pioneering green network practices. By combining technology and innovation with social responsibility, Turkcell leads projects that support education, entrepreneurship, and broader community development. Today, Turkcell stands as more than a connectivity provider—it is a trusted enabler of digital life, delivering high-quality services to millions of customers and shaping the future of Türkiye's digital ecosystem.

Company Overview: Huawei

Founded in 1987, Huawei is a leading global provider of information and communications technology (ICT) infrastructure and smart devices. We have approximately 208,000 employees and we operate in over 170 countries and regions, serving more than three billion people around the world. We are committed to bringing digital to every person, home and organization for a fully connected, intelligent world.

Huawei is working to build a fully connected, intelligent world. But it's increasingly clear to us that this world also needs to be green. The intelligent world we envision for the year 2030 will see low-carbon living truly gain traction. New forms of flexible production will help manufacturers more precisely match supply with consumer demand, while clean energy will see wider adoption as renewables go mainstream. By 2030, we expect 80% of digital infrastructure to use energy from renewables and expect energy efficiency to increase 100-fold. In this report, we will focus on how green development will change our lives and future industries. We aim to paint a compelling picture of a future where low-carbon living, renewable energy, fully-electrified transport, net-zero carbon buildings, as well as green industrial sector and digital infrastructure will play an active role in our lives. We believe that digitalization and decarbonization are the two most powerful driving forces behind green development.

Project Executive Summary

Turkcell, in partnership with Huawei, launched the FTTH Network Automation Project in 2024 to optimize energy efficiency, streamline operations, and elevate customer experience. By deploying Huawei's SingleFAN Pro solution, which integrates MA5800 OLTs with the NCE-FAN management and control platform, Turkcell introduced an innovative five-level OLT energy-saving system and intelligent ONT power management. This initiative achieves up to 1.88 GWh of annual energy savings—50% lower than CoC v8 standards—delivering \$300K in yearly Opex reductions while reducing environmental impact. At the ONT level, the solution further improves energy efficiency by 20%, reinforcing Turkcell's leadership in sustainable, future-ready networks.

Beyond energy optimization, the project enhances network scalability and operational excellence through intelligent automation. Key innovations include zero-touch ONT provisioning, OSS-integrated service deployment templates, and AI-driven remote diagnosis, alarm filtering, and inventory management. Together, these capabilities enable rapid service activation, efficient fault resolution, and improved visibility across the FTTH network, positioning Turkcell as a pioneer in AI-powered, green network operations.

Challenges Presented

Problem Statement:

Turkcell faced the dual challenge of managing the soaring operational costs and complexity associated with a rapidly growing Fiber-to-the-Home (FTTH) network. Key issues included unsustainable energy consumption from network equipment, inefficient and manual operational processes that hindered scalability, and a customer service model reliant on costly technician dispatches for installation and troubleshooting.

Specific Challenges:

- **High Energy Costs:** Network equipment, specifically Optical Line Terminals (OLTs) consumed significant power, leading to a substantial and growing operational expenditure (OPEX).
- **Operational Inefficiency:** Manual processes for service deployment, network maintenance, and fault localization were slow, prone to error, and did not scale effectively with network growth.
- **Customer Experience Friction:** The traditional requirement for a technician visit to install and activate each new customer service created delays, inconvenience, and high operational costs for Turkcell.

Constraints and Requirements:

- Develop an end to end automation FTTH solution for operational efficiency.
- Build AI-Driven, Multi-Layer Energy Savings architecture for suitability initiatives and positive impact on investment
- Data-Driven Management shifts operational model from reactive to proactive.
- Minimal customer impact and zero-touch provisioning from the customer side.

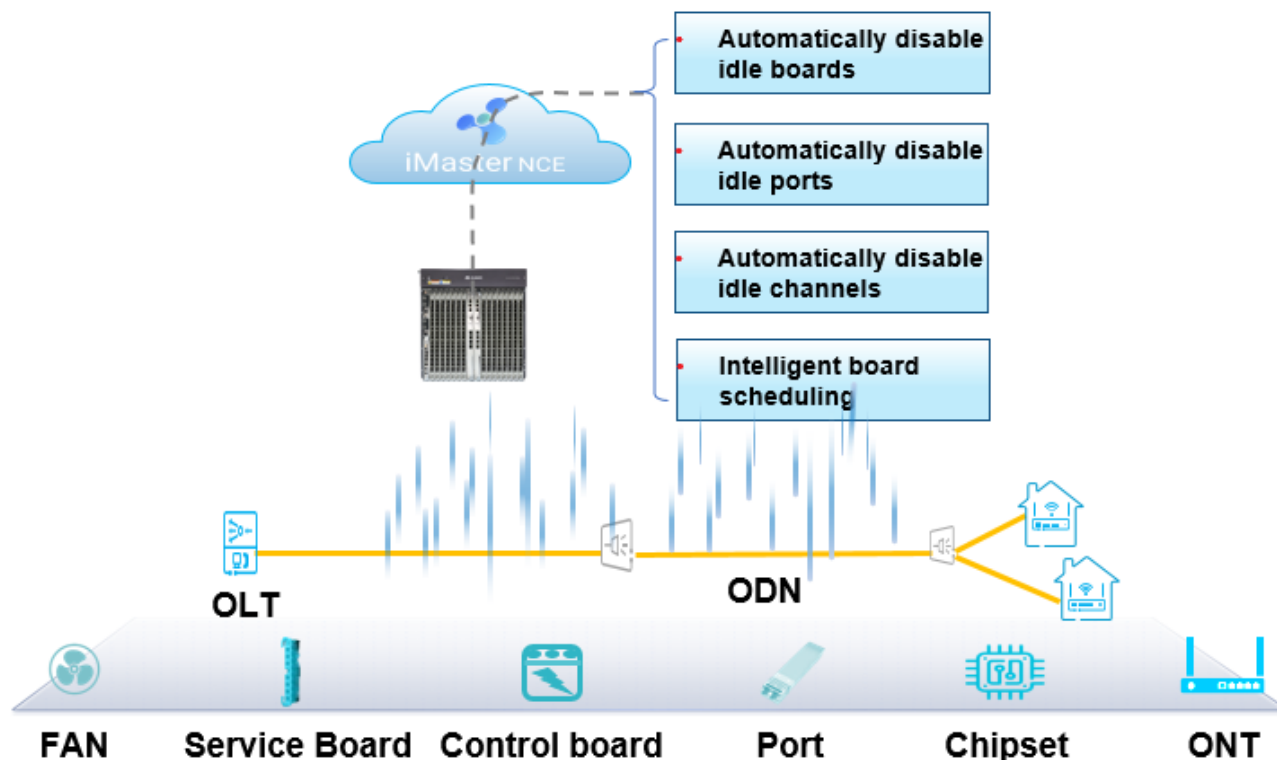
Solution & Value

Solution Approach:

Turkcell network come with end-to-end intelligent SingleFAN pro solution to its FTTH network, including MA5800 OLT and NCE-FAN management/control/analysis system, to optimize power consumption, network O&M efficiency, and enhance customer experience. Unique OLT 5-level intelligent dynamic energy-saving system, 50% lower than the CoC v8 standard. It achieves digital energy consumption across the entire network based on NCE, with multi-dimensional views for visibility and management.

Optimizing FTTH network power consumption levels:

- **Traffic Level:** Intelligently adjusts the voltage and frequency of forwarding chips based on board traffic.
- **Channel Level:** Automatically shuts down unused 10GPON or GPON channels in Combo optical modules.
- **Port Level:** Automatically or manually shuts down optical modules of unused ports.
- **Board Level:** Automatically powers down new boards without services.
- **Interface Level:** Closes idle high-speed backplane interfaces based on actual traffic.

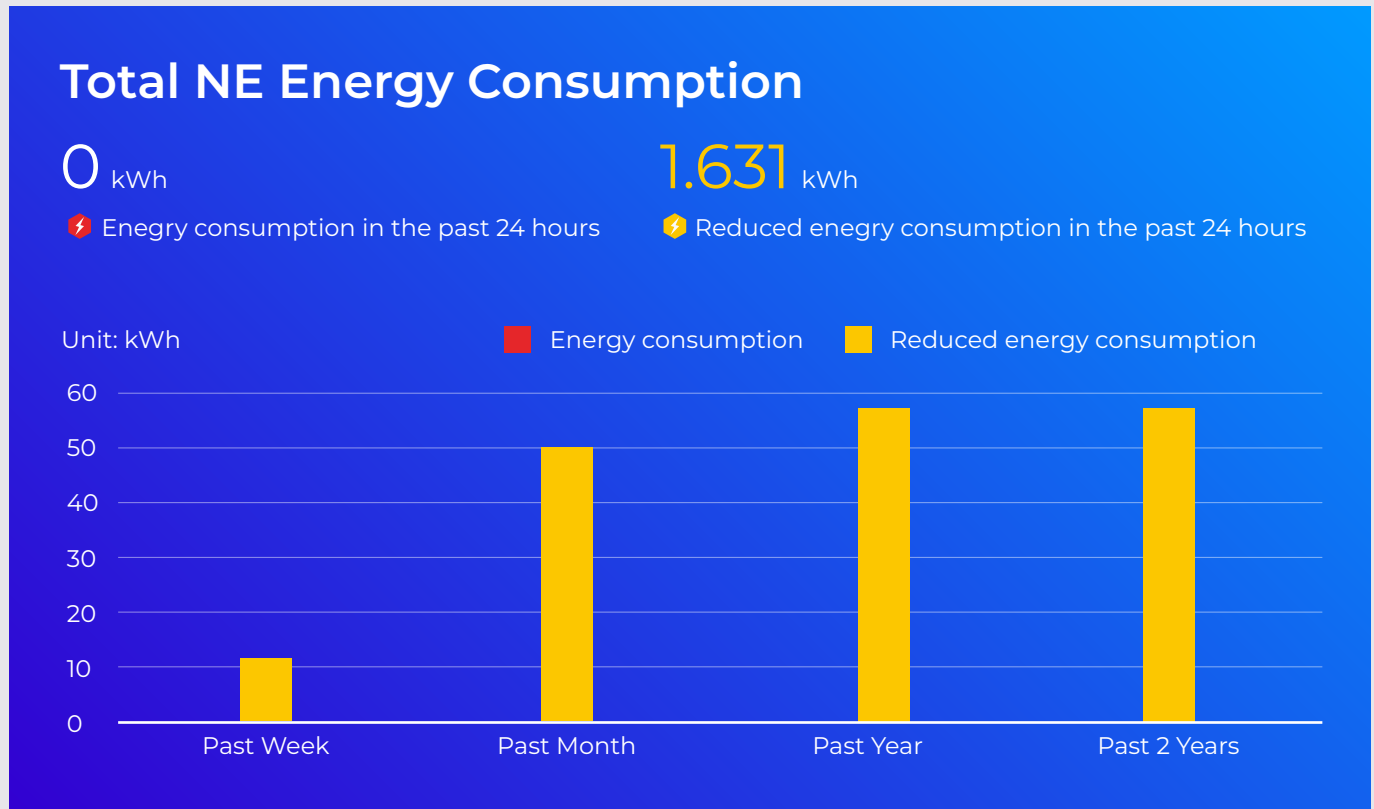
Diagram 1: **5-level intelligent dynamic energy saving architecture****Impact, Innovation, and Value:**

Solution impact: The project delivered a direct return on investment through revolutionary energy efficiency and enhanced customer experience.

- 1) Quantifiable OPEX Reduction:** The implementation of the unique 5-level intelligent dynamic energy-saving system for OLTs resulted in massive energy savings, reducing consumption by 1.88 GWh per year. This translated directly into \$300,000 in annual operational expenditure (OPEX) savings.
- 2) Improved Customer Experience:** The solution enabled Self-Installation and Self-Activation (Zero Touch Provisioning) for customers. This eliminated the need for costly and time-consuming technician dispatches, allowing for instant service activation and a superior user experience.

Scalability achieved: The architecture was designed for massive, seamless expansion and easy integration into existing business systems.

- 1) Open and Integrable:** The solution provides standard and open northbound interfaces, enabling fast and simple integration with any Operations Support System (OSS). This prevents vendor lock-in and facilitates large-scale, network-wide deployment.
- 2) Rapid Service Deployment:** Pre-defined FTTH Service Deployment Templates allow for "one-click" service provisioning for different customer segments. This ensures consistent, error-free, and rapid scaling to thousands of new subscribers without a proportional increase in operational effort.

Diagram 2: **Result of Deep mode energy saving from Network Cloud Engine**

Operational efficiency: The project transformed network management from manual and reactive to automated, intelligent, and proactive.

- 1) **Automated Workflows:** Key processes like service deployment, network backups, and scheduled batch upgrades are fully automated. This drastically reduces manual intervention, minimizes human error, and frees up engineering resources

Commercial Benefits:

The implementation of Huawei's AI-driven SingleFAN Pro solution delivered direct and significant commercial advantages:

Substantial OPEX Reduction:

Energy Savings: The 5-level intelligent energy-saving system reduced power consumption by 1.88 GWh per year, directly saving \$300,000 in annual OPEX.

Enhanced Operational Efficiency:

Faster Service Deployment: Automated, template-driven provisioning enabled "one-click" service activation, accelerating time-to-revenue. Zero-Touch Provisioning (ZTP) eliminated the need for on-site technician visits for installation, saving further operational costs.

Key Learnings:

- AI-Driven, Multi-Layer Energy Savings Directly Impact the Bottom Line, proving that sustainability initiatives can have an immediate and significant positive impact on profitability.
- End-to-End Automation is Critical for Operational Efficiency and Customer Experience.
- Proactive and Data-Driven Management shifts operational model from reactive to proactive.

HEAR FROM OUR MEMBERS:

REAL STORIES, REAL IMPACT

BUSINESS OPPORTUNITIES

“The collaboration between Ookla and the WBBA has been mutually beneficial, with Ookla sharing our global broadband performance and insights to aid the WBBA’s objective of overcoming industry challenges and supporting the drive towards the provision of broadband networks and services for all.”

- Kevin Hasley, VP Strategic Initiatives, Ookla

INDUSTRY LEADERSHIP

“Sharing industry experiences, learning from each other and being able to address common concerns to bridge the digital divide. That’s the value I see in WBBA Membership”

- Liu Zhiyong, Former Deputy Chief Engineer, China Telecom

COLLABORATION

“Broadband isn’t just about technology – it’s about opportunity. Together, Gamtel and the WBBA are working to bridge the digital divide and ensure a brighter future for all.”

- Pa Touray, Enterprise Risk Management to Quality Assurance, Gamtel

MEMBERSHIP BENEFITS



Full Member			Observer Member
	Industry thought leadership	• Have right to self-nominate as a candidate to run for election to a WBBA's Board of Directors • Have voting right in General Assembly • Membership status on WBBA website	
	Collaboration working groups (Global industry trends, Research & Development)	• Lead and contribute to Research Working Group • Contribute to ongoing industry development work • Develop best practices, whitepapers, proof-of-concept plans, and toolkits	• Trial invitation to attend as Observer up to 2 Working Groups
	Our Community	• Participate in quarterly all members meetings • Participate in special interest group meetings	• Invite to selected WBBA meetings and activities
	Industry Events	• Sponsor Webinars, Research Reports, and Digital Content • Event Conference sponsorship • Sponsor Networking activities • Participate in Content Committee • Speaking opportunities in WBBA events	
	WBBA Bespoke Events	• Invite to WBBA Broadband Congress Conference • Invite to WBBA General Assembly • Invite to represent WBBA in other industry events	• Invite to WBBA Broadband Congress Conference if relevant
	Global Knowledge Library	• Access to WBBA member-only online access hub including WBBA whitepapers, guidebooks and other documents • Access to Member-only resource and experts	• Access to WBBA member-only online access hub including WBBA whitepapers, guidebooks and other documents.

Disclaimer: WBBA reserves all rights to update the information from time to time at its own discretion.



About the World Broadband Association

The World Broadband Association (WBBa) is a multilateral, industry-led association, providing leadership for digital broadband innovation across the next decade.

Our objective is to overcome industry challenges and drive the provision of networks and services for all. We aim to accelerate the healthy development of the global telecom industry, creating sustainable benefits for stakeholders, end users, and society. The WBBa is an independent not-for-profit industry organisation registered in Switzerland.

Visit our website: www.worldbroadbandassociation.com